OFFICE OF WATER QUALITY TECHNICAL MEMORANDUM 2015.03

SUBJECT: Publication of Techniques and Methods Book 4, Chapter C4 “Design, Analysis, and Interpretation of Field Quality-Control Data for Water-Sampling Projects” by David K. Mueller, Terry L. Schertz, Jeffrey D. Martin, and Mark W. Sandstrom


The primary purposes of this report are to:

1. Provide guidelines for designing quality-control (QC) sampling programs for water-quality projects, and
2. Provide documentation for methods to analyze QC data and to evaluate the quality of environmental-sample data.

This report is intended to provide guidelines for all Water Mission Area and Water Science Center personnel and others who are involved in designing water-quality sampling for programs or projects and who are involved in analysis and interpretation of water-quality data.

The material in this report was developed for the USGS training class QW 2034 “Quality-Control Sample Design and Interpretation.” The approach that was developed for the training class has been refined over the years through more than 20 presentations of the lectures and invaluable experience gained from designing and collecting field QC samples in USGS projects.

The types of field QC samples discussed in this report include blanks, spikes, and replicates. The report provides guidance on incorporating these QC samples into a project design. The recommended QC design incorporates project-specific considerations, such as the objectives and scale of the study, and hydrologic and chemical conditions within the study area. Project personnel can use this guidance to determine where and when QC samples should be collected as well as how many QC samples are necessary.
QC data generated from the collection and analysis of QC samples are used to estimate potential “bias” and “variability” in environmental data. Bias is the systematic error inherent in a method or measurement system; variability is the random error that occurs in independent measurements. This report provides extensive information about statistical and other methods used to analyze QC data. The methods are used to compare QC results with the larger set of environmental data in order to determine whether the effects of bias and variability might interfere with interpretation of these data. Examples from published USGS reports are presented to illustrate how the methods are applied, how bias and variability are reported, and how the interpretation of environmental data can be supported, or must be qualified, based on the QC-data analysis. Equations are provided so that project personnel can apply these methods to the analysis of their own QC and environmental datasets.

This report does not cover topics such as development and implementation of quality-assurance plans or collection of QC samples. Some of these topics are covered in documents referenced in the report and also in the USGS National Field Manual for the Collection of Water-Quality Data.

Donna N. Myers
Chief, Office of Water Quality

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